

What is Claimed:

1. An apparatus for sealing a puncture extending from a patient's skin through tissue to a body lumen, comprising:

an elongate occlusion member comprising a proximal end and a  
5 distal end insertable into the puncture such that an expandable member on the distal end of the occlusion member is disposed within the body lumen while the proximal end remains outside the puncture;

a tensioner comprising an elongate body comprising a foot on  
10 a first end thereof and a saddle on a second end thereof, the foot having a shape for placement against the patient's skin adjacent the puncture, the saddle being moveable along the shaft towards the foot and biased to move away from the foot; and

cooperating connectors on the saddle and the proximal end of  
15 the occlusion member for securing the occlusion member to the saddle.

2. The apparatus of claim 1, further comprising a spring  
coupled to the piston for biasing the piston within the cylinder  
20 to move the saddle away from the foot.

2a The apparatus of claim 2, wherein the spring provides a constant biasing force as the saddle is moved relative to the foot to bias the saddle away from the foot.

5 2b The apparatus of claim 2, wherein the spring provides a variable biasing force as the saddle is moved relative to the foot to bias the saddle away from the foot.

3. The apparatus of claim 1, wherein the cooperating  
10 connectors comprise one or more fingers extending from the saddle and one or more grooves in the proximal end of the occlusion member for receiving the one or more fingers therein for securing the occlusion member to the saddle.

15 4. The apparatus of claim 3, further comprising a housing on the proximal end of the occlusion member, the housing comprising sets of grooves spaced apart from one another along the housing.

20 5. The apparatus of claim 1, whereupon the expandable member on the occlusion member is expandable from a collapsed state to allow insertion into the puncture and an expanded state to substantially seal the body lumen from the puncture, whereby

the saddle may be directed towards the foot, the cooperating connectors on the saddle and the occlusion member may be connected, and the saddle released, whereupon the saddle may move away from the foot to apply a proximal force on the occlusion member to maintain the expandable member against a wall of the body lumen to substantially seal the body lumen from the puncture.

6. The apparatus of claim 1, wherein the expandable member comprises an expandable frame and a membrane overlying at least a proximal portion of the frame.

7. The apparatus of claim 6, wherein the expandable frame comprises a plurality of struts that extend longitudinally in a collapsed state, the intermediate portions of the struts buckling and extending away from one another to define an expanded state, thereby causing the membrane to extend transversely to provide a mechanical tamp that may be applied against a wall of the body lumen to substantially seal the body lumen from the puncture.

8. The apparatus of claim 6, wherein the expandable frame is biased to an expanded state, the apparatus further comprising

a removable cover for restraining the expandable frame in a collapsed state to facilitate insertion into the puncture.

9. An apparatus for sealing a puncture extending from a patient's skin through tissue to a body lumen, comprising:

an outer member comprising a proximal end, a distal end having a size and shape for insertion into the puncture, and an inflation lumen extending between the proximal and distal ends, thereby defining a longitudinal axis therebetween;

an expandable member comprising proximal and distal ends, the proximal end of the expandable member being coupled to the distal end of the outer member such that an interior of the expandable member communicates with the inflation lumen, the expandable member being expandable from a collapsed state to an expanded state when fluid is introduced into the interior;

an inner member slidably coupled to the outer member and comprising proximal and distal ends, the distal end being coupled to the distal end of the expandable member;

a housing on the proximal end of the outer member, the housing comprising a chamber communicating with the lumen, a piston slidably disposed within the chamber and coupled to the inner member, and a reservoir filled with inflation media communicating with the chamber; and

an actuator on the housing that may be activated by a user to direct the inflation media from the reservoir into the chamber and the lumen, thereby substantially simultaneously expanding the expandable member and directing the piston proximally to pull the inner member proximally to shorten the expandable member as it expands.

10. The apparatus of claim 9, wherein the actuator may be deactivated to withdraw the inflation media from the chamber and the lumen into the reservoir, thereby substantially simultaneously collapsing the expandable member and directing the piston distally to push the inner member distally to lengthen the expandable member as it collapses.

11. The apparatus of claim 9, wherein the expandable member has a length, and wherein the length shortens as the expandable member expands such that the proximal and distal ends of the expandable member at least partially evert into the interior of the expandable member.

12. The apparatus of claim 9, wherein the piston is biased to move distally within the chamber for biasing the inner member distally relative to the outer member.

13. The apparatus of claim 12, further comprising a spring mechanism in the housing for biasing the piston to move distally within the chamber.

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14. The apparatus of claim 9, further comprising a tensioner comprising an elongate body comprising a foot on a first end thereof and a saddle on a second end thereof, the foot having a shape for placement against the patient's skin adjacent the puncture, the saddle being moveable along the shaft towards  
10 the foot and biased to move away from the foot, the saddle being connectable to the housing.

15. The apparatus of claim 14, further comprising  
15 cooperating connectors on the foot and the proximal end of the occlusion member for securing the housing to the saddle, whereby a proximal force may be applied to the expandable member relative to the foot.

20 16. The apparatus of claim 9, further comprising a tubular sheath comprising a proximal end, a distal end having a size and shape for insertion into the puncture, and a lumen extending therebetween, the distal end of the outer member being insertable

through the lumen of the tubular sheath until the expandable member is disposed beyond the distal end of the tubular sheath.

17. The apparatus of claim 16, further comprising a source  
5 of sealing compound coupled to the proximal end of the tubular sheath and communicating with the lumen in the tubular sheath such that the sealing compound may be delivered between the distal end of the tubular sheath and the expandable member.

10 18. An apparatus for sealing a puncture extending from a patient's skin through tissue to a body lumen, comprising:

an outer member comprising a proximal end, a distal end  
having a size and shape for insertion into the puncture, and a  
lumen extending between the proximal and distal ends, thereby  
15 defining a longitudinal axis therebetween;

an inner member slidably disposed within the lumen of the  
outer member and comprising proximal and distal ends;

an expandable member comprising proximal and distal ends,  
the proximal end of the expandable member being coupled to the  
20 distal end of the outer member, the distal end of the expandable member being coupled to the distal end of the inner member;

a housing on the proximal end of the outer member, the  
housing comprising a piston slidably disposed within a chamber,

the piston coupled to the inner member, and a reservoir filled with inflation media communicating with the chamber; and

an actuator on the housing that may be activated by a user to direct the inflation media from the reservoir into the

5 chamber, thereby directing the piston proximally to pull the inner member proximally and cause the expandable member to expand radially outwardly.

19. The apparatus of claim 18, wherein the expandable  
10 member comprises an expandable frame and a membrane overlying at least a proximal portion of the frame.

20. The apparatus of claim 19, wherein the expandable frame  
15 comprises a plurality of struts that extend longitudinally in a collapsed state, the intermediate portions of the struts buckling as the inner member is pulled proximally relative to the outer member, causing the struts to extend away from one another to define an expanded state.

20 21. The apparatus of claim 19, wherein the membrane extends transversely when the struts extend away from one another to provide a mechanical tamp that may be applied against a wall of



the body lumen to substantially seal the body lumen from the puncture.

22. The apparatus of claim 19, wherein the expandable frame  
5 is biased to an expanded state, the apparatus further comprising  
a removable cover for restraining the expandable frame in a  
collapsed state to facilitate insertion into the puncture.

23. A method for sealing a puncture extending from a  
10 patient's skin to a body lumen, comprising:

introducing a distal end of an occlusion member into the  
puncture with an expandable member thereon in a collapsed state  
until the expandable member is disposed within the body lumen;

expanding the expandable member to an expanded state within  
15 the body lumen;

placing a foot of a tensioner against the patient's skin  
adjacent the puncture, the tensioner comprising a shaft extending  
from the foot, and a saddle movable along the shaft towards the  
foot and biased to move away from the foot;

20 directing the saddle along the shaft towards the foot to  
reduce a distance between the saddle and the foot;

connecting the saddle to a proximal end of the occlusion  
member; and

releasing the saddle, whereupon the saddle automatically moves away from the foot, thereby applying a proximal force on the occlusion member to hold the expandable member against a wall of the body lumen and substantially seal the puncture from the  
5 body lumen.

24. The method of claim 23, further comprising introducing a sealing compound into the puncture with the expandable member substantially sealing the body lumen from the puncture.

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25. The method of claim 23, further comprising introducing a delivery sheath into the puncture, wherein the distal end of the occlusion member is introduced into the puncture through the delivery sheath, and wherein the sealing compound is introduced  
15 into the puncture through the delivery sheath.

26. The method of claim 23, further comprising collapsing the expandable member to a collapsed state, and withdrawing the occlusion member from the puncture.

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27. The method of claim 23, wherein the expandable member is expanded by removing a cover overlying the expandable member,

wherein the expandable member resiliently expands to an expanded state.

28. The method of claim 23, wherein the expandable member  
5 comprises a plurality of elongate struts, and wherein the  
expandable member is expanded by buckling an intermediate region  
of the struts outwardly.